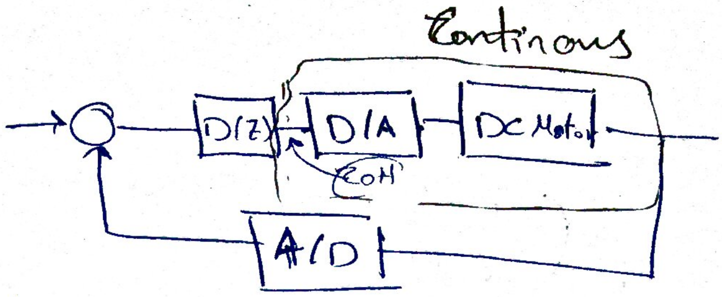
Discrete Equivalent Design Method

Phases of control system design

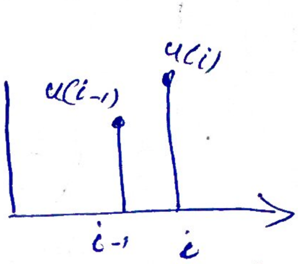
- Modeling
- Analysis
- Design
- Implementation

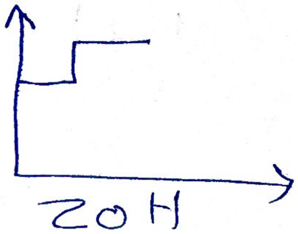


- Control Action: Value in Register

$$\underset{ZOH}{G}(s) = \frac{1-e^{-Ts}}{s}$$

$$G(z) = \mathcal{Z}\left[\underset{ZOH}{G}(s)\,\underset{Plan}{G}(s)\right]$$

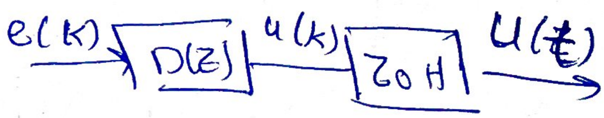




4- Implementation

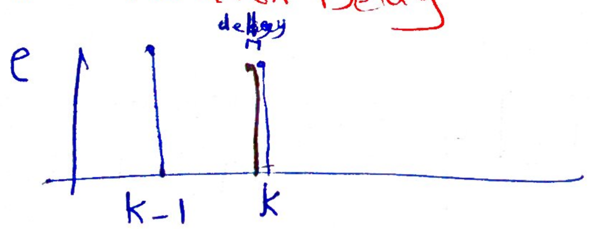
For designed Compensator

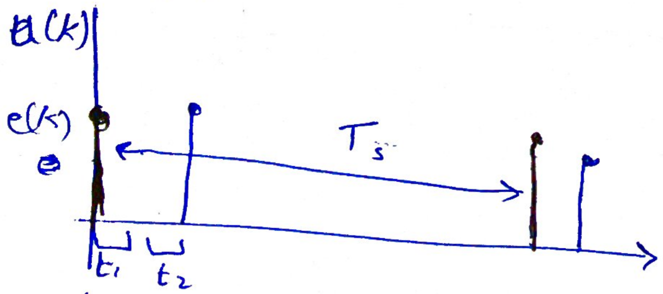
$$D(z) = \frac{az+b}{z+c} = \frac{U(z)}{E(z)}$$



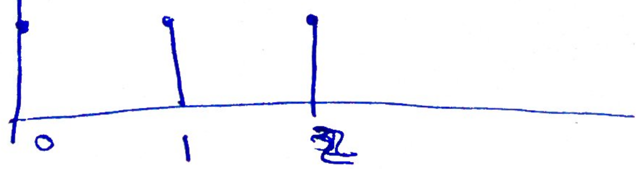
$$u(k) = a.e(k) + b.e(k-1) - c.u(k-1)$$

* Computation Delay





$$t_c \leq \frac{1}{10} T_s$$



$f_s > 10 f_1$

f_s → Sampling Frequency

f_1 → System Frequency

<u>state</u> is Pure integrator of the System.

Bilinear

$$S = \frac{2}{T}\left(\frac{Z-1}{Z+1}\right)$$

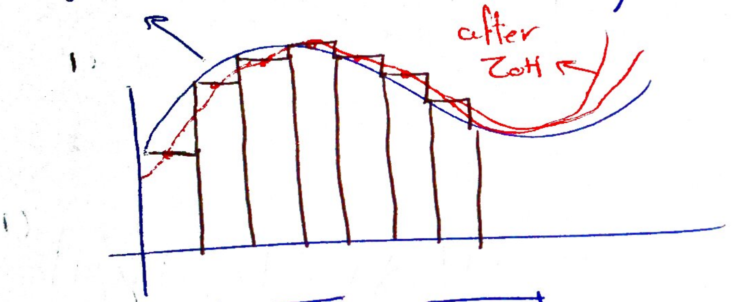
Controller in Discrete

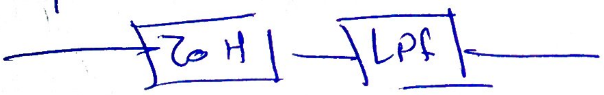
$D(Z) = D(s) \Big|_{S = \frac{2}{T}\left(\frac{Z-1}{Z+1}\right)}$

Difference eqn

$$u(k) = a.e(k) + b\,e(k-1) + c\,u(k-1)$$

Original Curve

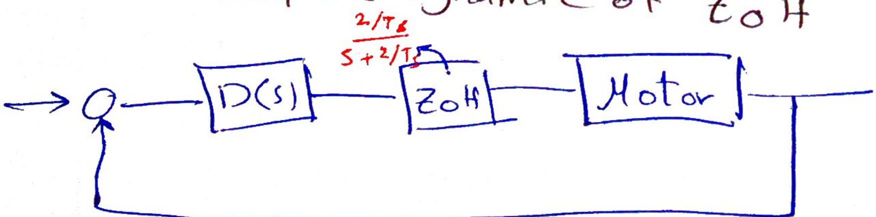




<u>LPF</u>: low Pass filter

So effect of ZoH ~~dy~~ delay by $\boxed{T/s}$

we have to Compute dynamic of ZoH



Dynamic of ZoH Approximated

$$G_{ZoH}(s) = \frac{2/T}{s + 2/T}$$

Assumption

- $f_s > 10 f_1$
- $t_c << T_s$

t_c → Computation time